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GB 2222667 A GB 1605190 A EP 0191306 A2
WO 91/11324 A1 US 4181768 A

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(54) **Blast containment structures**

(57) A blast containment structure e.g. refuse bin, post box, comprises an enclosure (10) having a wall (12) formed of a plurality of overlying sheets. Each sheet is formed of high tenacity fusible elements, surface elements of adjacent sheets being fused together to join the sheets to one another. The sheet may comprise a woven cloth formed from polypropylene filaments coated with a layer of propylene copolymer.

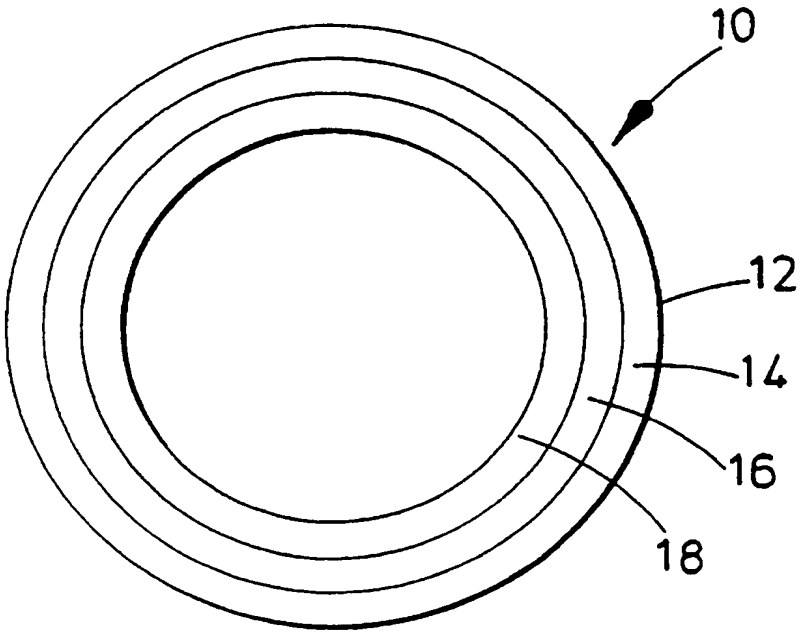

FIG.1

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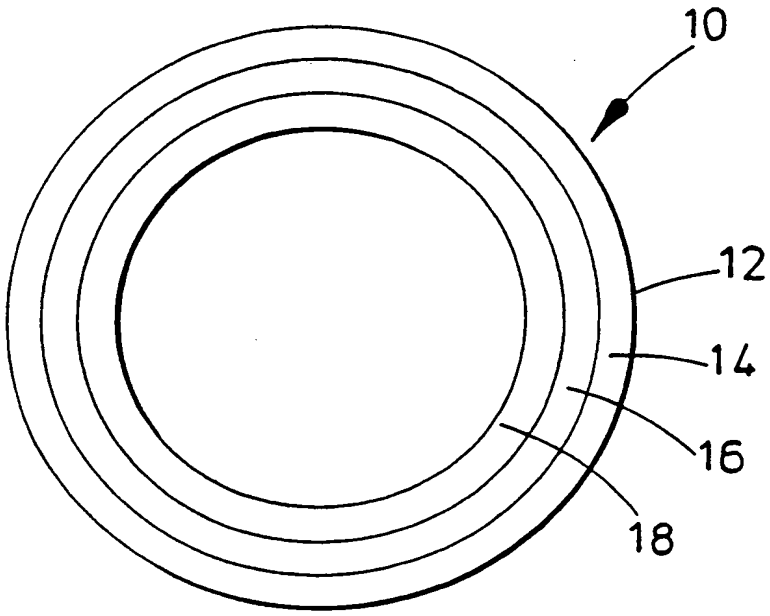

FIG. 1

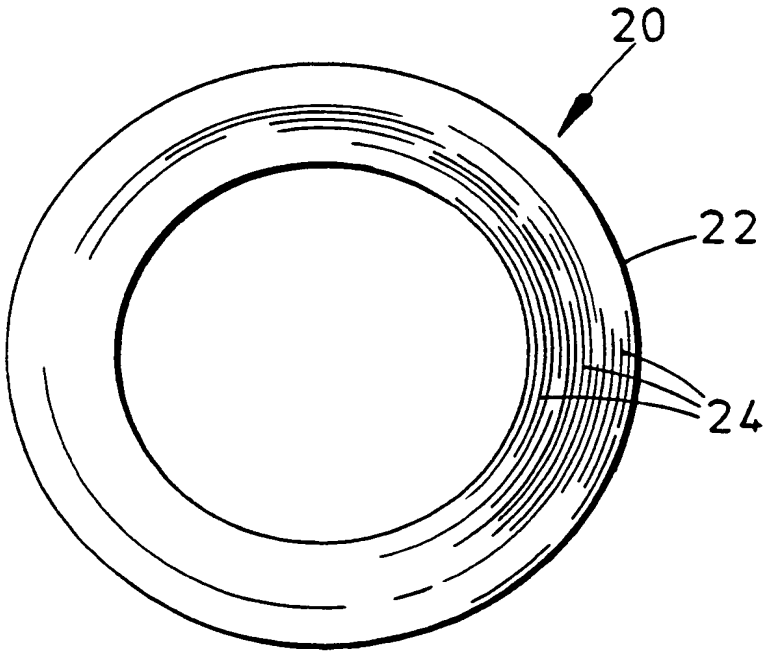

FIG. 2

IMPROVEMENTS IN AND RELATING TO BLAST CONTAINMENT STRUCTURES

This invention relates to a blast containment structure and a method of its production.

Blast containment structures may be utilized in a variety of applications, including containers for the storage and transport of explosive materials, or for use in sensitive areas for lining litter bins, post-boxes and the like to contain the blast from terrorist bombs which have been placed therein.

According to the present invention there is provided a blast containment structure comprising an enclosure having a wall formed of a plurality of overlying sheets, each sheet being formed of high tenacity fusible elements, and surface elements of adjacent sheets being fused together to join the sheets to one another.

According to a further aspect of the present invention there is provided a method of forming a blast containment structure comprising: providing sheets formed of high tenacity fusible elements; arranging said sheets in overlapping relation to define an enclosure; heating said enclosure to a temperature at or above the softening temperature of a fusible constituent part of the elements; and cooling the enclosure causing adjacent layers to fuse together.

It has been found that such enclosures are particularly effective in containing and partially absorbing the energy of a blast. Although not wishing to be bound by theory, it is believed that the provision of the overlapping fused sheets formed of high tenacity elements results in a structure which, to fail, requires the large number of relatively weaks fused bonds between each sheet to be broken. The accumulation of forces necessary to initiate failure of the many bonds is thus thought to create a sacrificial spaced armour providing a high rate of energy absorption before catastrophic failure.

Preferably, each element comprises a molecularly-oriented thermoplastic polymer base having at least one thermoplastic surface polymeric layer compatibly bonded to said polymer base by molecular interspersion between the contiguous surfaces of the adjoining base and surface layers, and said surface layer has a softening temperature lower than that of the polymer layer. Thus, the sheets are bonded together by heating the enclosure to a temperature at or above the softening temperature of each surface polymeric layer but below the softening temperature of the polymer base.

Preferably also, pressure is applied to the enclosure during the heating step to ensure contact between adjacent sheets. This may be achieved by providing the sheets in the form of a length of cloth and tightly winding the cloth around a heated mandrel.

Preferably also, the elements are elongate and are arranged to overlap within each sheet. Most preferably, during forming the elongate elements of each layer of the sheet fuse together at least at their intersections. The elongate elements may be interwoven or arranged in some other fashion to form the sheets.

Preferably also, the geometry of the enclosure is selected to provide uniform distribution of the force of a blast within the enclosure, cylindrical and spherical forms being particularly effective.

Preferably also, the enclosure includes displacement voids into which the delaminated sheets may expand. Such voids may be formed by providing unfused layers of sheet surrounding or located between the fused sheets.

Examples of suitable materials for use in the present invention are disclosed in our International Patent Application No. PCT/GB91/00132.

These and other aspects of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a somewhat schematic view of a blast containment structure in accordance with a first embodiment of the present invention; and

Figure 2 is a view of a blast containment structure in accordance with a second embodiment of the present invention.

Reference is first made to Figure 1 of the drawings

which illustrates a blast containment structure comprising a cylindrical enclosure 10 with a wall 12 comprising three tubes 14, 16, 18, the construction of which will be described below.

Each of the tubes 14, 18 comprises a plurality of sheets, each sheet formed of interwoven elongate elements. Each element has a polypropylene core or base having a surface layer of propylene copolymer which is compatibly bonded to the core by molecular interspersion. The elongate elements are woven into a cloth with unit weight 135 g/m^2. The tubes 14, 18 are formed by winding the cloth onto a hot mandrel of appropriate diameter to build-up a tube of total wall thickness of, in this example, 20 mm. The mandrel heats the sheet to a temperature at or above the softening temperature (110°C) of the propylene copolymer surface but below the softening temperature of the polypropylene core (165°C). Fusing temperatures are generally in range 130 - 150°C.

The outer tube 14 has a diameter some 80 mm greater than the inner tube 18 and the gap between the tubes 14, 18 is filled with a tube 16 of woven high tenacity polypropylene cloth, in an unfused state. The tube 16 thus provides a displacement void into which the delaminated tube 18 may expand.

Such an enclosure 10 will contain the blast from 0.5 kg of Semtex (RTM) explosive and is particularly effective in reducing the ricochet effect and absorbing fragments

with minimal spalling.

Reference is now made to Figure 2 of the drawings which illustrates an enclosure 20 with a wall 22 formed of layers of fusible bicomponent cloth 24, as described above with reference to the Figure 1 embodiment. The cloth 24, is wound onto a heated mandrel which may be a polypropylene or PVC tube (wall thickness 3 mm) until a wound cloth wall thickness of 38 mm is achieved.

In a further embodiment the woven cloth may be thermoformed during winding to give a complete hemispherical base or part hemispherical base to the cylinder.

In a further non-illustrated embodiment, cylinders of fused cloth, such as the tubes 14, 18 described above, may be used by themselves to provide liners for existing structures, such as litter bins or post-boxes.

From the above-described embodiments it will be clear that the present invention provides a relatively straightforward means of producing a blast containment structure, or improving the blast containment capabilities of an existing structure. It will also be clear to those of skill in the art that the above-described embodiments are merely exemplary of the present invention, and that various modifications and improvements may be made to the embodiments without departing from the scope of the invention.

CLAIMS

1. A blast containment structure comprising an enclosure having a wall formed of a plurality of overlying sheets, each sheet being formed of high tenacity fusible elements, and surface elements of adjacent sheets being fused together to join the sheets to one another.

2. The structure of claim 1 wherein each element comprises a molecularly oriented thermoplastic polymer base having at least one thermoplastic surface polymeric layer compatibly bonded to said polymer base by molecular interspersion between the contiguous surfaces of the adjoining base and surface layers, and said surface layer has a softening temperature lower than that of the base layer.

3. The structure of claim 2 wherein the elements have a polypropylene base and a surface layer of propylene copolymer.

4. The structure of claim 3 wherein the elements are provided in the form of a woven cloth with unit weight of around 135 g/m^2.

5. The structure of any one of the preceding claims

wherein the elements are elongate and are arranged to overlap within each sheet.

6. The structure of any one of the preceding claims wherein the elongate elements of each layer are fused together at least at their intersections.

7. The structure of any one of the preceding claims wherein the elongate elements are interwoven.

8. The structure of any one of the preceding claims wherein the geometry of the enclosure is selected to provide uniform distribution of the force of a blast within the enclosure.

9. The structure of any one of the preceding claims wherein the enclosure includes displacement voids into which the laminated sheets may expand.

10. The structure of claim 9 wherein said voids are provided by unfused layers of sheet surrounding or located between the fused sheets.

11. A method of forming a blast containment structure comprising:

providing sheets formed of high tenacity fusible elements;

arranging said sheets in overlapping relation to define an enclosure;

heating said enclosure to a temperature at or above the softening temperature of a fusible constituent part of the elements; and

cooling the enclosure causing adjacent layers to fuse together.

12. The method of claim 11 wherein each element comprises a molecularly oriented thermoplastic polymer base having at least one thermoplastic surface polymeric layer compatibly bonded to said polymer base by molecular interspersion between the contiguous surfaces of the adjoining base and surface layers, said surface layer having a softening temperature lower than that of the polymer layer, and bonding the sheets together by heating the enclosure to a temperature at or above the softening temperature of each surface polymeric layer but below the softening temperature of the polymer base.

13. The method of claim 12 wherein pressure is applied to the enclosure during the heating step to ensure contact between adjacent sheets.

14. The method of claim 13 wherein the sheets are provided in the form of a length of cloth and are tightly wound around a heated mandrel.

15. The method of claim 11 to 14 wherein the elements are elongate and are arranged to overlap within each sheet and during forming the elongate elements of each layer of the sheet are fused together at least at their intersections.

16. The method of any one of claims 11 to 15 wherein the elongate elements are interwoven to form the sheets.

17. The blast containment structure substantially as described herein and as illustrated in Figure 1 or Figure 2 of the accompanying drawings.

18. The method of forming a blast containment structure substantially as described herein.

Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report)

10.

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Relevant Technical Fields

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Search Examiner
DR N R CURTIS

Date of completion of Search
27 SEPTEMBER 1994

Databases (see below)
(i) UK Patent Office collections of GB, EP, WO and US patent specifications.

(ii) ONLINE DATABASE: WPI

Documents considered relevant following a search in respect of Claims :-
1-18

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
Y	GB 2222667 A	(D P COWARD) see page 1 lines 28-34	1-18
Y	GB 1605190 A	(PHILIP & PETROLEUM) see Example 1	1, 5, 6, 7, 8, 11, 15, 16
Y	EP 0191306 A2	(ALLIED CORP) see page 3, lines 5-10, page 6, lines 22-25, page 10, line 27, page 12, line 35 to page 13, line 30	1-3, 5-8, 11, 15, 16
Y	WO 91/11324 A1	(DON & LOW LTD) see Example 6	1-18
Y	US 4181768 A	(E I DU PONT) see column 1, line 44 to column 2, line 15	1, 5-8, 11, 15, 16

Database: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal